Learning outcomes

- At the end of this lecture, students should be able to:
  - understand what a dictionary is
  - create a dictionary object
  - add items to a dictionary
  - retrieve items from a dictionary
  - traverse the pairs in a dictionary

Python dictionaries

- A dictionary is a mapping from a key to its associated data value.
  - Each key maps to a value.
  - The key has to be unique and an immutable object.
  - A phone book is an example of a mapping: the key is the person’s name (plus address) and the associated value is their phone number.
  - You can think of a dictionary as a list of pairs, where the first element of the pair, the key, is used to retrieve the second element, the corresponding value.
  - Note: The key and its associated value is called a key-value pair or it can be called an item.

Creating an object of type dict

- Curly braces are used for dictionaries and {} is a dictionary which contains no key-value pairs, i.e., an empty dictionary:
  ```python
def main():
    english_italian = {}
    print(english_italian)
    print(type(english_italian))
main()
```

- Another way to create an empty dictionary object is (does exactly the same thing as the code above):
  ```python
def main():
    english_italian = dict()
    print(english_italian)
    print(type(english_italian))
main()
```
dict is a Python type

Note that the name, `dict`, is a Python type and should not be used as a variable name.

```python
def main():
    english_italian = dict()
    main()
```

Creating a dictionary which contains pairs

A dictionary object can be initialised with key-value pairs:
- Each associated pair is separated by `:` and the pairs are separated by commas.

```python
def main():
    english_italian = {'yes': 'si', 'bye': 'ciao', 'no': 'no', 'maybe': 'forse', 'thank you': 'grazie'}
    print(english_italian)
    contacts = {'Jill': 3456, 'James': 3456, 'Yi': 7654, 'Syed': 6754}
    print(contacts)
    main()
```

```python
{'yes': 'si', 'bye': 'ciao', 'no': 'no', 'maybe': 'forse', 'thank you': 'grazie'}
{'Jill': 3456, 'James': 3456, 'Yi': 7654, 'Syed': 6754}
```

Note: the keys have to be unique but the associated values do not.

Visualising the dictionary

```python
def main():
    contacts = {'Jill': 3456, 'James': 3456, 'Yi': 7654, 'Syed': 6754}
    print(contacts)
    main()
```

```python
{'Jill': 3456, 'Syed': 6754, 'James': 3456, 'Yi': 7654}
```

Note: when the key-value pairs are printed, the order is not predictable.

Immutable

- The keys of a dictionary must be of a type which is immutable such as: string, int, tuple.
- The keys of a dictionary must be unique.
- The values can be of any type and they do not need to be unique.

Remember: lists are mutable. Keys cannot be of type list.
Dictionaries are not ordered structures

- Dictionary elements cannot be accessed using the index value. A dictionary is a collection of key:value pairs.
- There is no predictable order to the key:value pairs in a dictionary (the order may change as new pairs are added and removed).

Adding a pair to the dictionary

- Key-value pairs can be added to the dictionary using assignment statements:

```python
def main():
    contacts = {"Jill": 3456, "James": 3456, "Yi": 7654, "Syed": 6754}
    contacts["Jerry"] = 7004
    print(contacts)
main()
```

Output:
```
{'Jerry': 7004, 'Syed': 6754, 'Yi': 7654, 'Mark': 7654, 'Jill': 3456, 'James': 3456}
```

Changing the associated value in a dictionary

- The associated value of a pair can be changed by assigning a different value to the dictionary key. This replaces the old value.

```python
def main():
    contacts = {"Jill": 3456, "James": 3456, "Yi": 7654, "Syed": 6754}
    contacts["Jill"] = 7654
    contacts["Yi"] = 7004
    print(contacts)
main()
```

Output:
```
{'Syed': 6754, 'Yi': 7004, 'James': 3456, 'Jill': 7654}
```

Access the value associated with a key

- The value associated with a certain key can be accessed using square brackets (enclosing the key):

```python
def main():
    contacts = {"Jill": 3456, "James": 3456, "Yi": 7654, "Syed": 6754}
    name1 = "Jill"
    name2 = "James"
    print(name1, "is at extension ", contacts[name1])
    if contacts[name1] == contacts[name2]:
        print(name2, "has the same extension")
main()
```

Output:
```
Jill is at extension: 3456
James has the same extension
```
The number of key-value pairs in a dictionary

- The `len()` function can be used with a dictionary object to find out how many key-value pairs are currently in the dictionary:

```python
def main():
    contacts = {"Jill": 3456, "James": 3456, "Yi": 7654, "Syed": 6754}
    print(len(contacts), "in dictionary")
    contacts["Yi"] = 7654
    contacts["Jerry"] = 7004
    print(len(contacts), "in dictionary")
main()
```

4 in dictionary
5 in dictionary

Check if a key is in the dictionary

- The `'in'` operator can be used to check if a key is in the dictionary:

```python
def main():
    contacts = {"Jill": 3456, "James": 3456, "Yi": 7654, "Syed": 6754}
    name = "Jack"
    if name in contacts:
        print(name, "is at extension: ", contacts[name])
    else:
        contacts[name] = 0
        if name in contacts:
            print(name, "is at extension: ", contacts[name])
    print(contacts)
main()
```

Jack is at extension: 0
{'Jill': 3456, 'James': 3456, 'Yi': 7654, 'Syed': 6754, 'Jack': 0}

The in operator with dictionaries

- An error is raised when accessing a key which is not in the dictionary. Usually you test before accessing a key-value pair:

```python
def main():
    contacts = {"Jill": 3456, "James": 3456, "Yi": 7654, "Syed": 6754}
    if "Jill" in contacts:  # Test first
        print("Jill", ", contacts["Jill"])
    print(contacts["Izzy"])
main()
```

Jill - 3456
Traceback (most recent call last):
File "LectureCode.py", line 5, in <module>
    print(contacts["Izzy"])
KeyError: 'Izzy'

Traversing the pairs in the dictionaries

- Use a `for` loop to traverse (visit) each key in the dictionary:

```python
def main():
    contacts = {"Jill": 3456, "James": 3456, "Yi": 7654, "Syed": 6754}
    for name in contacts:
        print(name, ", contacts[name]
main()
```

Checks:
Yi - 7654
Jill - 3456
Syed - 6754
James - 345

```python
def main():
    contacts = {"Jill": 3456, "James": 3456, "Yi": 7654, "Syed": 6754}
    for key in contacts:
        print(key, ", contacts[key]
main()
```

Same code
Exercise

"Story.txt" is a text file.
The following program reads the text from the file, converts it to lower case, and creates a dictionary of all the unique words which start with a vowel ("a", "e", "i", "o", "u").
Note: the key is the vowel and each word is added to an associated list (the list grows as the text is processed).

```python
def main():
    vowel_words_dict = get_dictionary_from_file_words("Story.txt")
    display_results(vowel_words_dict)

def get_dictionary_from_file_words(filename): #complete the code
    # Create a dictionary (key: vowel letter, value: empty list)
    # Open the parameter file, read the contents, convert the contents to lower case
    # Split a single string into a list of words
    # For each word in the contents
    #   • If the first letter is a vowel letter
    #   • append the word to the corresponding list in the dictionary

def display_results(vowel_words): #complete the code
    main()
```

**Algorithm**

The `get_dictionary_from_file_words()` function:

- **Parameter:** input file,
- **Returns:** a dictionary

Create a dictionary (key: vowel letter, value: empty list)

Open the parameter file, read the contents, convert the contents to lower case

Split a single string into a list of words

For each word in the contents
- if the first letter is a vowel letter
- append the word to the corresponding list in the dictionary

Kahoot

Create, play and share fun learning games for …

How to play

- On their personal devices, players can then join by going to kahoot.it in their web browser (on install the kahoot app to your own device), and entering the pin displayed on the screen at the front of the room
- They then enter their nickname, seeing it displayed at the front
- They then use their device to answer each question, with the aim to get as many points as possible and get to the top of the leaderboard
- [https://www.youtube.com/watch?v=v2JbY979WUg](https://www.youtube.com/watch?v=v2JbY979WUg)
- Let's start the first one…

Exercise

Story.txt

A small trouble is like a pebble. Hold it too close to your eye, and it fills the whole world and puts everything out of focus. Hold it at the proper distance, and it can be examined and properly classified. Throw it at your feet and it can be seen in its true setting, just another tiny bump on the pathway of life.
**get_dictionary_from_file_words()**

Complete this:

```python
def get_dictionary_from_file_words(filename):
    vowel_words = {"a":[], "e":[], "i":[], "o":[], "u":[]}
    file = open(filename, "r")
    words = file.read()
    words = words.lower()
    words = ______________________
    vowels = "aeiou"
    for word in words:
        if word[0] ____________:
            key_part = word[____]        #get the first char
            (_________ [key_part]).append(_________)
    return vowel_words
```

**display_results()**

The display_results(vowel_words) function:

Parameter: the dictionary

```python
def display_results(vowel_words):
    for _____ in vowel_words:
        print(_____, "-*-*", ___________________)
```

**Summary**

In Python:
- Dictionaries are used to store key:value pairs (items)
- A dictionary object can be created in two ways
- Items can be added to a dictionary
- Items can be retrieved from the dictionary
- The pairs in a dictionary can be traversed using for ... in

```python
def display_results(vowel_words):
    for _____ in vowel_words:
        print(_____, "-*-*", ___________________)
```

**Python features used in this lecture**

```python
english_italian = {"yes":"si", "bye":"ciao", "no":"no", "maybe":"forse", "thank you":"grazie"}
def display_results(vowel_words):
    for _____ in vowel_words:
        print(_____, "-*-*", ___________________)
```

```python
english_italian["never"] = "mai"
print(english_italian["bye"])
for word in english_italian:
    print(english_italian[word])
print(len(english_italian))
```